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THE EFFECT OF HUSBAND'S INCOME AND
WIFE'S EDUCATION UPON VARIOUS BIRTH ORDERS

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INTRODUCTION

The lower the order of the birth, the more positive the relationship between it and husband's income,* *ceteris paribus*. That is, this study finds that a given increment of income has a more positive effect on (a) the probability of a family going from n or less children to $(n + 1)$ or more children, than on (b) the probability of a family going from $(n + 1)$ or less to $(n + 2)$ or more children. In absolute terms, the relationship between income and another birth is curvilinear, positive at low birth orders but negative at high birth orders, *ceteris paribus*.

With respect to wife's education, it is found that the higher the order of the birth, the more negative is the relationship between an additional birth and the wife's education, *ceteris paribus*. That is, the more children the family already has, the stronger is the effect of higher wife's education upon the family not to have additional children.

These findings, obtained from a cross-sectional multi-variate study of the 1960 U.S. Census, are regular and strong, making them particularly welcome in an area of inquiry in which there is currently a great deal of interest** but in which many of the results about economic variables--especially about the effect of income--are mixed and controversial.

*"Income" means husband's income throughout this paper unless otherwise noted. Family income is a much more complex concept in fertility analysis than is husband's income because of the effect of husband's income upon the wife's labor-force decision, and consequently upon her fertility.

**Some examples of the burgeoning literature, largely stimulated by Becker (1960; 1965) and Mincer (1963) are: Ben-Porath (1970; 1972), Cain and Weininger (1972), Cho et al. (1970), DeVanzo (1972), DeTray (1970), Harman (1970), Michael (1970), Nerlove and Schultz (1970), Preston (1972), Sanderson and Willis (1970), Schultz (1969), and Willis (1969).

The findings presented here were not originally deduced from a general model of fertility. But they make sense within the general context of the Mincer (1963)-Becker (1965) model as developed by Willis (1969), Ben-Porath (1970), and others.

METHOD

The general method is to finely sub-classify the 1-in-1000 1960 U.S. Census sample by various demographic characteristics, and then to apply discriminant analysis within each cell. Where the dependent variable is limited to two groups--as is the case here where the two groups in each fertility variation are (i) families with $\leq n$ children and (ii) families with $> n$ children--discriminant analysis is equivalent to regression analysis, and the two terms will therefore be used interchangeably throughout the paper. The independent variables of interest here are husband's income and wife's education, but some other factors are included in the discriminant function to hold them constant.

Now to be more specific about the method: The units of observation are women, ages 35-54, with husband's present. The observations are then sub-classified by race (white-non-white), degree of urbanization of residence place (urban with more than 50,000, urban with less than 50,000, rural non-farm, rural farm), age of wife at marriage (< 22 , ≥ 22), husband's occupation (eight standard categories), and husband's education (≤ 8 , 9-12, ≥ 13 years). In Set I of the runs the observations were additionally sub-classified by wife's age (35-44, 45-54). In Set II the observations were additionally sub-classified by wife's age and by whether the wife was in the labor force. In Set III the observations were additionally sub-classified by wife's education (≤ 8 , 9-12, ≥ 13 years) and whether the wife was in the labor force, but not by her age (to prevent the cells from getting too small).

The reason for using this device of fine sub-classification* is that it is intrinsically the best possible way to hold factors constant and render homogeneous the observations upon which a regression is run. It is superior in this regard to holding factors constant by entering them as independent variables in the regression, because the latter device linearizes the effects of these other factors though they may well not be linear.** The reason why one may nevertheless choose the latter device in some situations is to insure that the number of observations within cells is large enough to conduct the desired analysis. In the situation at hand, the price in reduction in observations seems acceptable because of the relatively large number of observations in the original 1-in-1000 census sample.

The dependent variable in each regression is a dichotomous yes-no variable, where the two categories in each fertility variation are whether the wife has n or less children, or more than n children. In the first of the six variations the two categories contain wives with zero children and those with one-or-more children, respectively; this variation is designated as the $n = 0$ run. In the second ($n = 1$) variation the categories are zero or one child, and two or more children. There are six variations, the $n = 5$ variation having wives with zero to five children in one category, six or more children in the other. The discriminant function finds those values of the independent variables that most effectively separate the observations into the two dependent-variable categories.

* Hanoch (1965) used much the same device.

** Using dummy variables for the parameters has the related though milder effect of applying the same constant to all observations.

The implicit meaning of the coefficient of an independent variable in such a function is that it is a measure of the influence of that variable on the likelihood of the family proceeding from the category with n children or less to the category with $n + 1$ children or more. Such a coefficient does not directly tell us the probability of a family going from exactly n to exactly $(n + 1)$ children; that probability would be estimated by a discriminant analysis on samples of people with exactly n and with exactly $n + 1$ children. This was not done here because the numbers in the cells would necessarily be much smaller than the numbers in the cells used here. But there is no statistical reason to think that the signs and relative sizes of the coefficients would be different in the two methods.*

The independent variables were: husband's income, years of education of wife, years of education of husband, age of wife at marriage, and wife's age. The latter three variables (and also wife's education in Set III of the runs) were both variables of classification and variables within the regression, to aid in holding constant the variables to be treated as parameters in the analysis of the effect of husband's income and wife's education.

* Earlier, regressions (not discriminant functions) were run on the dependent variable truncated to different extents. The variations had the following fertility scales: 0, 1+; 0, 1, 2+; ... 0, 1, 2, 3, 4, 5, 6+, where all the highest-birth-order groups were assigned the number shown for the "+" group in each variable. The sizes of the coefficients showed the same trend patterns as the discriminant function with dichotomous variables given here, though in absolute terms at higher parities the signs for income were less likely to be negative than in the discriminant analyses. This is to be expected because of the greater weight given to lower birth orders in the high- n truncated regressions than in the high- n discriminant function.

Discriminant functions were run in each cell that contained more than 10 observations. The sub-classification scheme produces a great many such regressions, ranging from over 200 to over 500 in the various sets of runs and variations. The numbers of cells with more than 10 non-whites were relatively small, and hence few enter the analysis. Each regression was treated as a meta-observation, and the conclusions drawn here are based on the central values of the aggregates of the several hundred regressions conducted in each fertility variation. That is, instead of running a single regression and calculating a single set of estimating coefficients for each variation, as would be done if all variables were included in the regression rather than used as variables of classification, many regressions were run for each variation--one for each cell with enough observations--and the central values of the coefficients for each variable were used as the estimates of the effects of the variables.

The most reliable estimation for the effect of a given variable in the group of runs in a given variation is the ratio of the coefficients that are positive to those that are negative. For example, in the $n = 0$ variation in the runs that are sub-classified by wife's age (Set I), the income coefficients in 211 cells were positive, while 141 were negative. (Zero coefficients were not counted). The ratio $(211/141) = 1.5$ is an index of the direction of income's effect in that variation, to be compared with $(220/155) = 1.42$ for the $n = 1$ variation in that set of runs, and so on, as seen in Table 1. A coefficient greater than unity implies a positive effect, and a coefficient less than unity implies a negative effect.

This comparison is not biased by the proportions of families in the two dependent-variable categories, as would be a comparison of the mean or median coefficients. This is because the split in numbers of observations between the dependent-variable categories is different in different variations, being far from a 50-50 split for the $n = 0$ and $n = 5$ runs, but closer to 50-50 for the $n = 2$, and

n = 3 variations. That is, few families have as few as zero or as many as 6 children. And the sizes of the coefficients of individual regressions are affected by the proportions of cases in the two categories, thereby biasing the comparison of the sizes of coefficients.*

RESULTS

The Effect of Husband's Income

The effect of husband's income on various birth orders may be seen by looking across the rows for Sets I-III in Table 1. Higher husband's income is positively associated with the family having at least one child rather than none. The relationship then moves smoothly from positive to negative as one looks to the higher birth orders. There comes to be a negative association between the husband's income and additional children about around the third or fourth child. That is, though higher income increases the probability that the family will have more children when they have no children or one, higher income decreases the probability that they will have additional children when they already have as many as three, four or more.** No meaning can be attached to the absolute sizes of the ratios because they depend on the numbers of observations; if the cells contained more observations and hence had less sampling error, and if there were no bias from the permanent-income effect in the cross-section, the ratios on both sides of unity could be expected to be much farther from unity.

* If one were to use the method of running a single regression for each variation, handling all variables within the regression, the coefficients of the various birth-order variations would similarly be biased relative to one another. This is another reason for preferring the method used here.

An intuitive explanation of the bias is that the farther is the split from 50-50 in the number of observations in the dependent-variable categories, the less information is contained in the observations. A distribution of observations approaching 0-100 would necessarily yield a coefficient of 0.

** There can be little doubt of the statistical significance of this trend among the set of observations in Table 1 (and in Table 2 to follow). The most obvious

foot note cont.

proof is the very low probability of a perfect or almost-perfect monotonic relationship among even one set of six observations, let alone two or three such sets. And the size of the differences--the ratio for $n = 0$ being less than half the ratio for $n = 5$ --only makes the statistical significance more conclusive. For those who like formal significance tests, the simplest device is to lump and compare the three left-hand cells and the three right-hand cells in one set such as Set I in Table 1. We ask the probability that a sample of 548 positive signs out of 899 observations and a sample of 346 positive signs of 784 (proportions of .61 and .44 respectively) came from the same universe. By a binomial test of proportions the Z is 2.3 and probability is .02 (two-tailed). But further, this is a very inefficient test of the difference among results in even a single set, and it takes account of only one of the five runs in the Tables 1 and 2 that reinforce each other. Hence, the probability of the observed set of results in Tables 1 and 2 occurring by chance is far far less than .02.

Table 1

These results imply that the effect of husband's income is curvilinear among people in the United States, *ceteris paribus*. This goes in the direction of explaining the "convergence" of Americans to two-four child families and away from families with fewer or more than 2-4 children as income as risen secularly in the United States during the 1900's and before. As we shall see, however, the data provide a stronger explanation for the phenomenon of convergence. Of course all else besides income is not held perfectly constant in such a cross-section study--less than in the case of income being raised in a short time-period for all the population. Given that so many variables are held constant in this particular cross-section analysis, however, it would not seem amiss to think that the cross-sectional results would also describe behavior over time reasonably accurately.

A less-positive effect of husband's income on higher birth orders could be explained on the grounds of diminishing marginal utility of additional children. But neither this nor any other simple explanation tells why the effect should

TABLE 1

The Effect of Husband's Income on Various Birth Orders

The ratio of positive income coefficients to negative income coefficients among discriminant functions of the form: dichotomous fertility category = f (husband's income, education of wife, education of husband, age at marriage, wife's age).

Variables of Sub-Classification:	Fertility categories in dependent variable					
	0, 1+	0-1, 2+	0-2, 3+	0-3, 4+	0-4, 5+	0-5, 6+
In all runs: race, urbanity, husband's education, age at marriage (< 22, 22+), husband's occupation						
Additional variables of sub-classification for various runs as shown:						
Run Set:						
I. Wife's age:	1.96 N=287	1.8 N=317	1.12 N=317	-.82 N=326	.78 N=320	.80 N=327
II. Wife's age; whether wife is in labor force:	1.68 N=419	1.60 N=474	.94 N=482	-.73 N=538	.73 N=487	.74 N=489
III. Wife's education; whether wife is in labor force:	1.50 N=352	1.42 N=389	1.07 N=389	.66 N=389	.60 N=399	.64 N=392

Interpretation:

Compare across the rows. Numbers greater than unity indicate a positive relationship between husband's income and fertility, on the average; numbers less than unity show a negative association. The sample size, N, shows the number of cells with more than ten observations in which the regression coefficients were non-zero.

become negative at high birth orders. In a one-variable analysis it might well be that the systematic association of husband's income with wife's education would explain the phenomenon, wife's education's effect dominating at higher parities. But wife's education is held constant in the present analysis, and especially rigorously in Set III; still the effect of husband's income is negative at higher parities. Nor would an association of income with infecundity or with contraceptive knowledge provide an answer, the latter being well accounted for by the education variables. It is possible that the "quality" elasticity of children with respect to income is sufficiently higher than the "quantity" elasticity to produce the observed negative effect at higher birth orders, as suggested by Becker (1960) and others. That is, it may be that higher income induces a family to wish to spend more on each of its children, and that this demand for "quality" is much more responsive to income than is the number of children they desire. But surely this is not a solid answer.

All in all, it seems that there is a puzzle here, and one of considerable magnitude. Though apparently similar to the Galbraith-Thomas (1941-1956) display of successively less association between the business cycle and marriage, low parities, and higher parities, the mechanism in their time-series is likely to be different: The Galbraith-Thomas association is likely to be mostly a matter of timing, as shown by the particularly strong effect on marriages. In contrast, the Census data on women 35-54 reflect mostly completed fertility and hence do not indicate timing shifts except insofar as temporary timing and spacing decisions became unintendedly permanent.

The Effect of Wife's Education

The effect of wife's education on various birth orders may be seen by looking across the rows in Table 2.* It is clear that more education is

* Data are not given in Table 2 for Set III in which wife's education was a variable of classification, because most of the effect of education was captured by the gross breaks in the sub-classification. Nevertheless, all coefficients of wife's education were less than unity--showing the negative effect on fertility of additional education for the wife even within the restricted ranges of education. For $n=0$ to $n=5$ the coefficients were .84, .74, .77, .66, and .83, respectively.

associated with having fewer children at all birth orders. This is well-explained by the higher wage that a wife with more education can command in the labor force, as argued and demonstrated by Mincer (1963) and many others. But the effect is markedly sharper at the higher birth orders, especially in the more meaningful Set I in which the wife's labor-force participation is not a variable of classification.*

There would seem to be no explanation for this phenomenon by way of the wife's market value in the labor-force. That is, there is no strong reason to believe that a given increment of education represents a greater value in the labor market when a woman has four or five children than when she has one or two; if anything, one would expect the opposite. Nor do economies of household scale explain this phenomenon; if anything, the fourth or fifth child would seem to make less additional demands in goods and home care than the first or second child. So there is a puzzle here, too.

Table 2

The negative effect of women's education on all birth orders together with the curvilinear effect of husband's income on various birth orders offer a reasonably strong explanation for the convergence phenomenon. Higher husband's income causes an increase in women's education. It is reasonable that the positive effect of higher husband's income at low birth orders leads to fewer families having zero or one child while dominating the relatively mild opposite negative effect of women's education. At high parities, the negative effect of husband's income and the very negative effect of the additional women's education caused by higher income work in the same direction to reduce the number of high-order births.

*Classifying by labor-force participation takes out some of the effect of wife's education because wife's education is systematically associated with labor-force participation. This explains why the effect of wife's education is stronger in Set I than in Set II.

TABLE 2

The Effect of Wife's Education on Various Birth Orders

The ratio of positive to negative wife's education coefficients among discriminant functions of the form: dichotomous fertility category = f (husband's income, education of wife, education of husband, age at marriage, wife's age)

Fertility categories in dependent variable

Variables of Sub-Classification:

In all runs: race, urbanity, husband's education, age at marriage (<22, 22+), husband's occupation
Additional variables of sub-classification for various runs as shown:

Run Set:

I. Wife's age:

II. Wife's age; whether wife is in labor force:

	0-1	0-1	0-2	0-3	0-4	0-5
	.73	.69	.54	.50	.42	.39
	N = 302	N = 313	N = 313	N = 301	N = 294	N = 246
	.87	.74	.74	.66	.53	.53
	N = 432	N = 474	N = 485	N = 459	N = 395	N = 315

Interpretation: Numbers greater than unity indicate a positive relationship between wife's education and fertility, on the average; numbers less than unity show a negative association. The sample size, N, shows the number of cells with more than ten observations in which the regression coefficients were non-zero.

IMPLICATIONS

Perhaps the most important implication of this work is the warning that it offers for multivariate work in fertility: If the dependent variable is taken to be "total children ever born to a wife who has completed fertility," confusion will be introduced about the influence of the economic (and other) independent variables. This is because, as the results presented here show, in a sample of people with different completed family sizes income acts in different directions on different-size families, and wife's education will be acting with different intensity on families of different sizes. This not only implies a confused interpretation of the effect of husband's income in a multivariate study whose dependent variable is completed fertility, but it also must inevitably make more difficult the construction of a general model of fertility.

The results of this study with respect to income offer a possible explanation of the confusingly-different signs of the husband's income coefficient found in various samples. For example, in a sample of prosperous suburban households, where high birth orders are seldom reached, one is more likely to get a positive income coefficient than in a sample of poorer and less-educated people in an LDC, many of whom have large families. And the result with respect to income offers an alternative explanation of the Sanderson-Willis (1971) interaction explanation of their finding that, holding wife's education constant, the partial effect of husband's income is negative at low income levels (among whom the largest proportion of high birth orders are to be found) but positive at high income levels (where most children are lower birth orders).*

The general implication of these results, then, is that research into the influences upon fertility ought to focus on the causes of the transition from each specific birth order to the following birth order, rather than working with the full range of completed fertility.

* Ben-Porath (1972) has offered still another alternative explanation--that the relationship between fertility and women's education is curvilinear.

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